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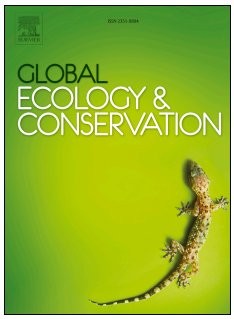
2019-10

Cardoso , P , Branco , V V , Chichorro , F , Fukushima , C S & Macías-Hernández , N 2019 , ' Can we really predict a catastrophic worldwide decline of entomofauna and its drivers? ' , Global Ecology and Conservation , vol. 20 , 00621 . https://doi.org/10.1016/j.gecco.2019.e00621

http://hdl.handle.net/10138/304102
https://doi.org/10.1016/j.gecco.2019.e00621

# Accepted Manuscript

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PII: S2351-9894(19)30138-6

DOI: https://doi.org/10.1016/j.gecco.2019.e00621

Article Number: e00621

Reference: GECCO 621

To appear in: *Global Ecology and Conservation*

Received Date: 10 March 2019

Revised Date: 5 April 2019

Accepted Date: 5 April 2019

Please cite this article as: Cardoso, P., Branco, V.V., Chichorro, F., Fukushima, C.S., Macías-Hernández, N., Can we really predict a catastrophic worldwide decline of entomofauna and its drivers?, *Global Ecology and Conservation* (2019), doi: https://doi.org/10.1016/j.gecco.2019.e00621.

# Can we really predict a catastrophic worldwide decline of entomofauna and its drivers?

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A recent paper by Sánchez-Bayo & Wyckhuys (2019; hereafter S&W) reviewed the drivers and declining rates of insects worldwide, pointing to the global extinction of 40% of insects within the next few decades. Although the authors made a great effort to review the literature based on long-term insect surveys in different geographical regions and taxa, the conclusions of this study should be taken with caution. The biased methods and flawed analyses used by S&W lead to unsupported conclusions on the extinction of vast numbers of insect species in the near future. The results of S&W received short-term attention in the global media, but we believe this might undermine the credibility of insect conservation efforts, environmental sciences in general, and even the peer review process.

As partly pointed out by other authors (Komonen *et al.*, 2019; Thomas *et al.*, 2019; Wagner, 2019), caution is needed when reading S&W, given the number of limitations in the data used, statistical analyses and interpretation of results. The bias in the paper starts with the collection of data itself, which is biased in search terms used, geographical coverage and study focus. To quantify the

proportion of declining species, S&W only considered papers reporting declining trends in insect abundance, as revealed by their choice of search terms (Komonen *et al.*, 2019; Wagner, 2019). It is known that, even if outweighed by losers, there are also species that increased in abundance (Powney *et al.*, 2019). In addition, although the study makes assumptions for the worldwide decline in insect biodiversity, the selected surveys were mostly limited to North America and Europe (Wagner, 2019). Only 3 studies out of 73 had been done in tropical areas and even though they recognise this flaw, S&W still state that "insect declines appear to be similar in tropical and temperate regions of the world". Finally, it seems that most studies selected by S&W focused on the consequences of agricultural intensification, including the use of fertilisers and/or pesticides. Hence, it is impossible to know if the trends found are due to this bias (Wagner et al., 2019).

The statistical methodology by S&W also presents numerous flaws. To start with, the authors state that "conservation status of individual species follows the IUCN classification criteria", but that is not true (see also Komonen *et al.*, 2019 for other problems in the application of the IUCN criteria). Their criteria make no reference to the timescale of the decline which should be of 10 years or three generations, whichever is the longer. Also, the threshold used for critically endangered species (75%) is found nowhere in the IUCN guidelines, it should be either 80 or 90%, the latter only if the causes are reversible, understood and ceased. Contrary to what is stated, they have not performed a meta-analysis, but improperly used vote-counting. As performed, vote-counting is not informative, as it might simply reflect the past interests of researchers. Some claims, such as "About half of Coleoptera and Lepidoptera species (both moths and butterflies) are declining at a faster rate than the annual average", are not informative at all. When following a normal distribution, half of the observations should naturally fall under the average value.

The end result of S&W is a biased, poorly supported message. The authors go as far as claiming that some of their supporting papers back up an apparently preconceived idea that the most important factor contributing to insect losses is agriculture intensification connected with pesticide

use, downplaying other factors such as habitat loss, fragmentation, invasive species or climate change (Wagner, 2019). In reality, few if any of the studies tested the drivers of decline, including agriculture intensification, only mentioning them as possible, unquantified, causes (e.g. Hallmann *et al.*, 2017). S&W comes across as cherry-picking or just misrepresentation of the sources. This bias would be almost understandable considering the great effort it would take to correctly tackle such a topic, but discredited literature can undermine future conservation efforts by painting scholars as fearmongers.

There is plenty of data and anecdotal evidence reflecting the extinction risk for numerous insect species and their declining abundances (Leather, 2018; Janzen & Hallwachs, 2019; Powney *et al.*, 2019). Such evidence includes thousands of species assessed as threatened in the IUCN Red List. But the global decline is still unquantified, and we support previous calls for more evidence, not of the known decline, but of its magnitude and drivers (Leather, 2018; Habel *et al.*, 2018; Thomas *et al.*, 2019; Wagner, 2019). There are many better ways to reach the goals of S&W. These include searching for an unbiased and global representation of the problem in the literature, using only comparable data and taking advantage of existing raw data (e.g. the PREDICTS: https://www.predicts.org.uk/ and BioTIME: http://biotime.st-andrews.ac.uk/ databases), as well as using reliable meta-analysis tools and interpreting any results without preconceived notions on the importance of multiple factors causing insect decline. But fundamentally, this study underlines the lack of data on species abundances across space and time, i.e., the Prestonian Shortfall (Cardoso *et al.*, 2011). Only with proper data and analyses can one derive any conclusions regarding a future insect and consequent ecosystems apocalypse.

**Acknowledgements**

David Wagner, Fernando Urbano, Marija Milicic and Candida Ramos commented on a previous version of the manuscript. PC, FC and CSF are supported by grants from Koneen Säätiö: "Trait-Based Prediction of Extinction Risk" and "Global trade of live tarantulas". VB is supported by the Erasmus+ EU Programme. NMH is supported by the Marie Skłodowska Curie grant "Biodiversity drivers on islands and continents".

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